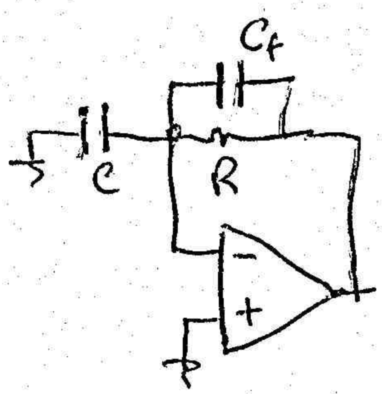
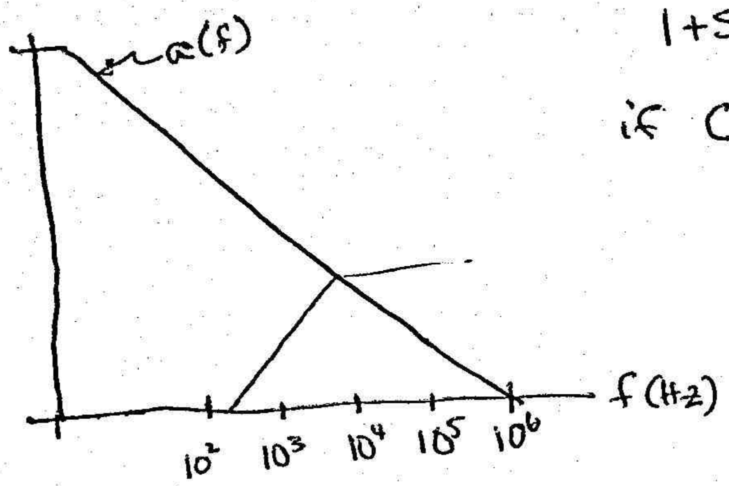
8-14




$$Z_2 = \frac{1}{sC_f} \parallel R = \frac{R/sC_F}{R + 1/sC_F} = \frac{R}{1+sC_FR}$$

$$\beta = \frac{1/sC}{Z_2 + 1/sC} = \frac{1}{sCZ_2+1}$$

$$= \frac{1}{\frac{sCR}{1+sC_FR}+1} = \frac{1+sC_FR}{1+sR(C+C_F)}$$




if $C >> C_f$

$$f_z \cong \frac{1}{2\pi RC} = 202\text{ HZ}$$

↳ zero of $1/\beta$

For $\phi_M = 45°$ select $f_p$ to lie at the geometrical average of $f_z$ and $f_t$

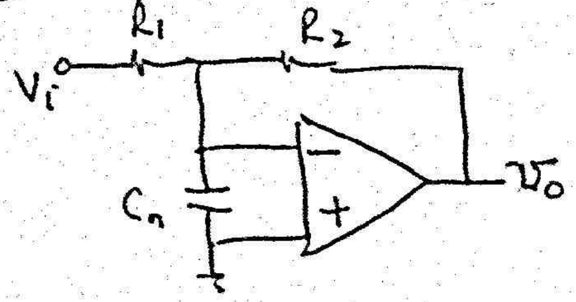
$$f_p = \sqrt{(202.23)(10^6)} = 14.22\text{ KHZ}$$

$$C_F = \frac{1}{2\pi R f_p} = \frac{1}{2\pi(78.7k\Omega)(14.22\text{ KHZ})}$$

$\boxed{C_F = 0.142\text{ nF}}$ ← << 10nF as expected.

142pF

8-18




(a) $C_n = C_d + \frac{1}{2} C_c + C_{ext} = 16\,pF$

$GBP = 20\,MHz$

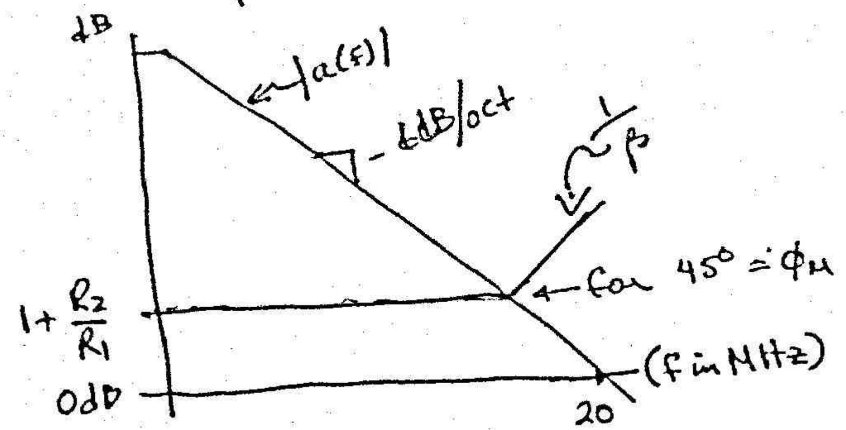
$\beta = \dfrac{Z_1}{Z_1 + R_2}$ ; $Z_1 = \dfrac{R_1 \, 1/sC_n}{R_1 + 1/sC_n}$

$$Z_1 = \frac{R_1}{1 + sC_nR_1} \Rightarrow \beta = \frac{R_1 / 1 + sC_nR_1}{R_2 + R_1/1 + sC_nR_1}$$

$$\beta = \frac{R_1}{R_2 + sC_nR_1R_2 + R_1} = \frac{R_1}{R_1 + R_2} \cdot \frac{1}{1 + sC_n(R_1 \| R_2)}$$

$$= \frac{1}{1 + R_2/R_1} \cdot \frac{1}{1 + sC_n(R_1 \| R_2)}$$

$$\frac{1}{\beta} = \left(1 + \frac{R_2}{R_1}\right)\left[1 + sC_n(R_1 \| R_2)\right]$$




$1 + \frac{R_2}{R_1} = 2 = 6\,dB$

$\therefore$ place $f_z$ at 10MHz

$$\frac{1}{2\pi C_n (R_1 \| R_2)} = 10\,MHz \Rightarrow R_1 \| R_2 = \frac{1}{2} R_1 = \frac{1}{2} R_2$$

$$\frac{1}{2} R_1 = \frac{1}{2\pi (16\,pF)(10^7\,Hz)}$$

$R_1 = R_2 = 2(995\,\Omega) = \boxed{1989.5\,\Omega}$

(b) for $\phi_M = 60°$

$\tan\left(\frac{f_t}{f}\right) = 30° \rightarrow f_z = \dfrac{f_x}{\tan 30°} = 17.3\,MHz$

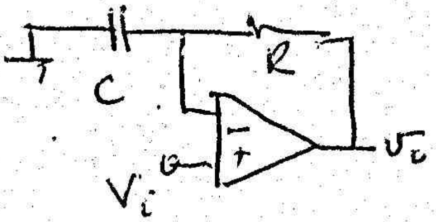
$\boxed{R_1 = R_2 = 3445.9\,\Omega}$

advantages: requires no aditional parts, less noise advantages : requires no aditional parts , less noise

disadvantages : more output current flows through feedback network. Larger effect of Thevenin resistance.

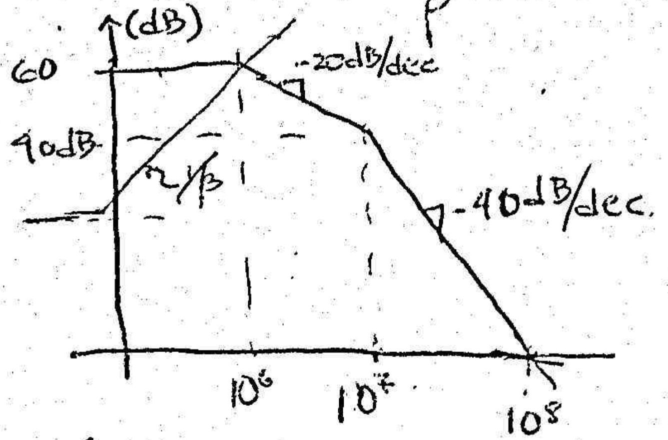
8.27

(a) $a_o = 10^3\ V/V$, $f_1 = 10^6\ Hz$, $f_2 = 10^7\ Hz$




$$\beta = \frac{1/sC}{R + 1/sC} = \frac{1}{sCR+1}$$

$$\frac{1}{\beta} = sCR + 1$$




If the $1/\beta$ curve is made to cross the a curve at the first pole then the system is stable with $\phi_m = 45^\circ$

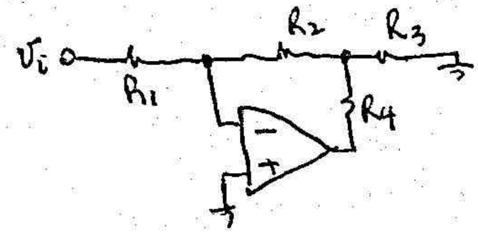
(b) Select

$$\frac{1}{2\pi RC} = 10^3\ Hz \quad (3 \text{ decades below } f_1)$$

Let $\boxed{C = 1nF}$, $R = \dfrac{1}{2\pi(10^{-9})(10^3)} = \boxed{\dfrac{1M\Omega}{2\pi}}$

(c) SS bw is the freq. at which $1/\beta$ crosses the "a" curve. So $BW = f_1 = 1MHz$

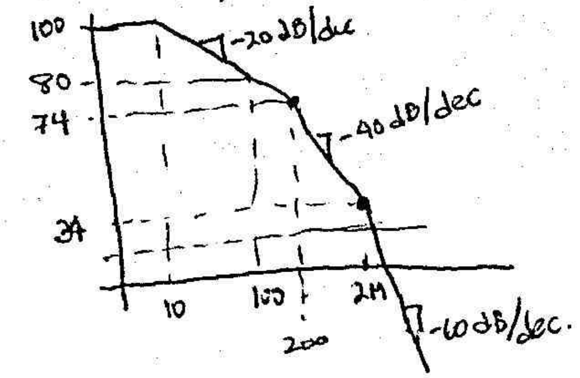
8-36




(a)
$$\beta = \frac{R_1}{R_1+R_2}\,\frac{(R_1+R_2)\|R_3}{R_4+(R_1+R_2)\|R_3}$$

$$= \frac{1}{2}\,\frac{200\|10}{200\|10+100} \cong \frac{1}{23}$$

$a_0 = 10^5\ \mathrm{V/V}$, $f_1 = 10\,\mathrm{KHz}$, $f_2 = 200\,\mathrm{KHz}$, $f_3 = 2\,\mathrm{MHz}$




$\frac{1}{\beta} = 27.2\,\mathrm{dB}$

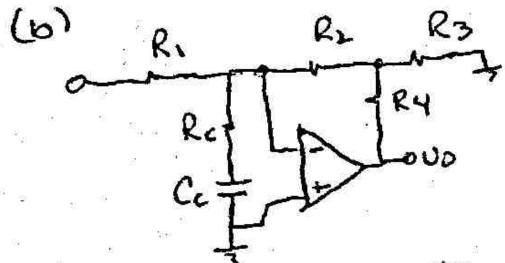
($\beta$ crosses $|a|$ a bit above 2MHz

$\therefore$

$$\therefore\ \phi < -\tan^{-1}\left(\frac{2M}{10K}\right) - \tan^{-1}\left(\frac{2M}{200K}\right) - \tan^{-1}\left(\frac{2}{2}\right) = -219^\circ$$

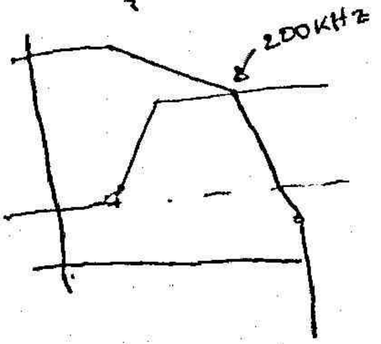
and the amp. is unstable.

(b)




let $R_a = R_1 \| R_c$

$$\beta = \frac{R_a}{R_a+R_2}\,\frac{(R_a+R_2)\|R_3}{R_4+(R_a+R_2)\|R_3}$$




Gain at $2^{nd}$ pole is $\sim$ 100dB
$\underline{-\ 29\,\mathrm{dB}}$
71 dB

$\cong 3550 = \frac{1}{\beta}$

$$\frac{1}{\beta} = \left(1+\frac{R_2}{R_a}\right)\left[\frac{10\|(100+R_a)}{100+10\|(100+R_a)}\right]^{-1} \cong 3550$$

Let $10\|(100+R_a) \simeq 10$

$$\left(1+\frac{100}{R_a}\right)\frac{110}{10} \simeq 3550$$

$$R_a = \left(\frac{11^{-1}(3550)-1}{100}\right)^{-1} = 31\ \Omega$$

$$.311\,\Omega = 100K \| R_c =$$

$$R_c = \frac{1}{\frac{1}{.311}-\frac{1}{100}} = \boxed{312\ \Omega}$$

$$C_c = \frac{5}{\pi(312\,\Omega)(200\,\mathrm{KHz})} = \boxed{25.5\,\mathrm{nF}}$$

8.38

(a) $Z_1 = \frac{1}{sC_c} \| R = \frac{R/sC_c}{R + 1/sC_c} = \frac{R}{sC_cR+1}$

$$\beta = \frac{Z_1}{Z_1 + 1/sC} = \frac{R/1+sC_cR}{R/1+sC_cR + 1/sC} = \frac{sCR}{sCR + 1 + sC_cR}$$

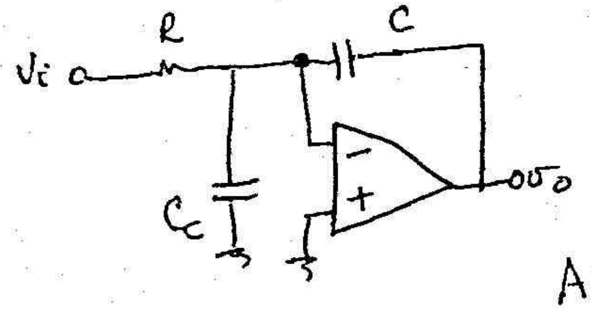
$$\beta = \frac{sCR}{1+s(C_c+C)R}$$

$$\frac{1}{\beta}(f=\infty) = 1 + \frac{C_c}{C} = 5 \rightarrow \boxed{C_c = 4C = 160pF}$$

(b) $f_x = \frac{GBP}{5} = 16MHz$

∴ Circuit behaves as a single-pole opamp. up to 16MHz

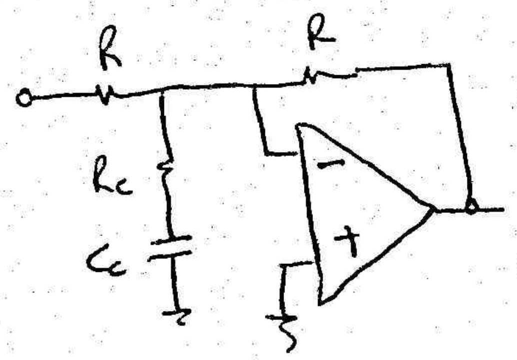
$$A_{ideal} = \frac{-1}{sCR}$$




Above $\frac{1}{\beta}$ is for non-inv. version of the circuit

$$A(s) = \frac{-1}{sCR} \frac{1}{1+j(f/f_x)}$$

8.40 $GBP = 80MHz$, $\beta_{max} = 0.2 V/V$ ; $\frac{1}{\beta_{max}} = 5 V/V$



$$R_c = \frac{R}{5-(1+1)} \quad \text{(eq. 8.30)}$$

$$R_c = \frac{R}{3} \rightarrow \text{let } \boxed{\begin{matrix} R_c = 10K \\ R = 30K \end{matrix}}$$

$$f_x = \frac{80MHz}{5} = 16MHz$$

$$C_c = \frac{5}{\pi R_c f_x} \quad \text{(eq. 8.31)}$$

$$= \frac{5}{\pi (10K\Omega)(16MHz)}$$

$$\boxed{C_c = 10pF}$$

$$A(s) = (-1 V/V) \frac{1}{1 + j\, f/\underbrace{16MHz}_{f_x}}$$